Pavement Preservation Task Group

A Caltrans/Industry Joint Venture

Recycling Co-Champions

Joseph F. Peterson, PE, Caltrans North Region

Donald M. Matthews, PE, Pavement Recycling Systems, Inc.

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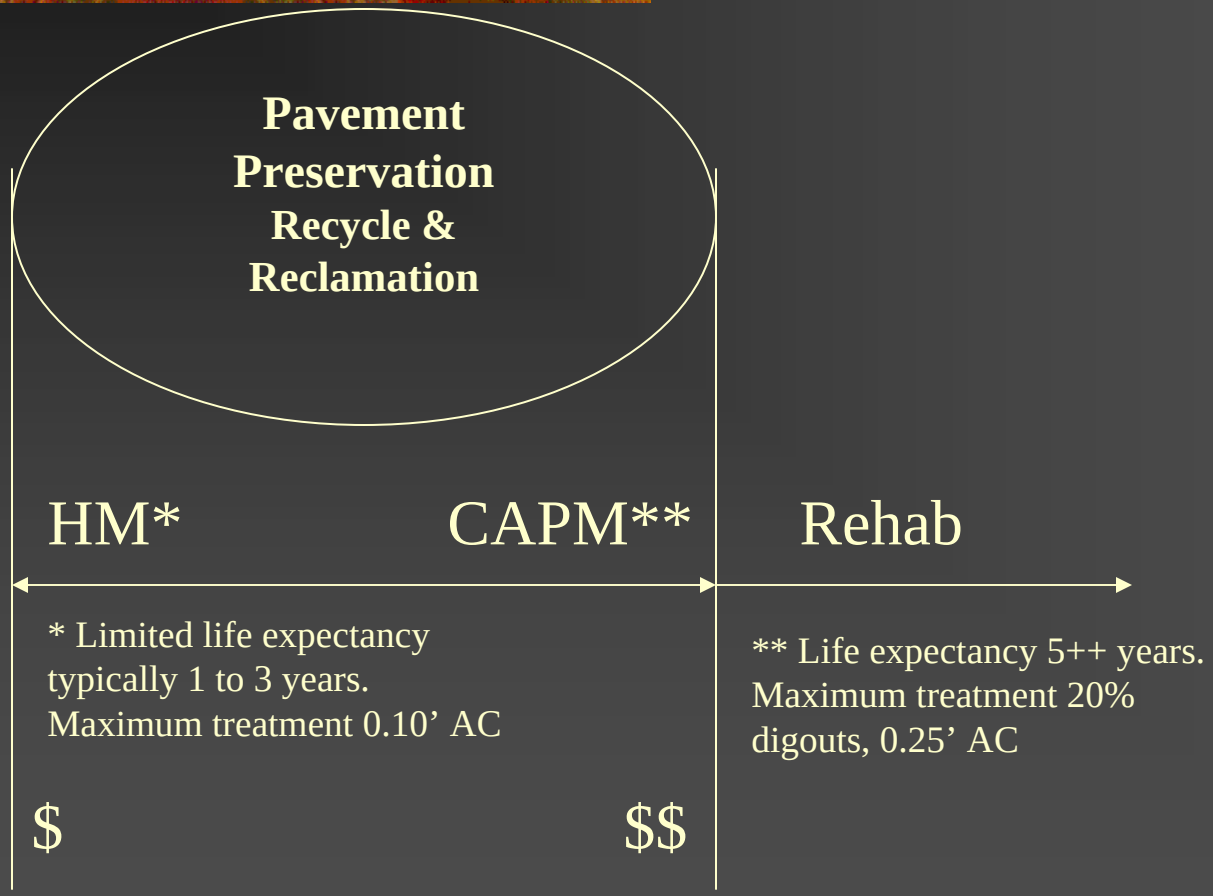
Purpose of Recycling PPTG Sub-Task Group

- Promote Recycling Benefits
- Help Develop and Coordinate Within Caltrans SSP's for Recycling
- Educate and Innovate (at least for CA)
  - Caltrans, Industry, and Local Agencies
  - Dispel the Myths and Stop the Fear!!
- Help Caltrans Get up to Speed With the Rest of the Country and World

How Recycling and Pavement Preservation Fit Together



Benefits of Recycling

- Reuses and Conserves Non-renewable Natural Resources
- Preservation of Environment and Reduction in Land Filling
- Energy Conservation/Reduces Truck Traffic
- Possible Recycling Credits for Diversion
- Reduction in User Delays During Construction
- Improved Pavement and Structural Section Physical Properties
- Some of Our Best Aggregates are In Place
- Cost Savings Over Traditional Methods (Caltrans 10 to 15%) (Industry and Local Agencies 25% to 50%)

Recycling Methods

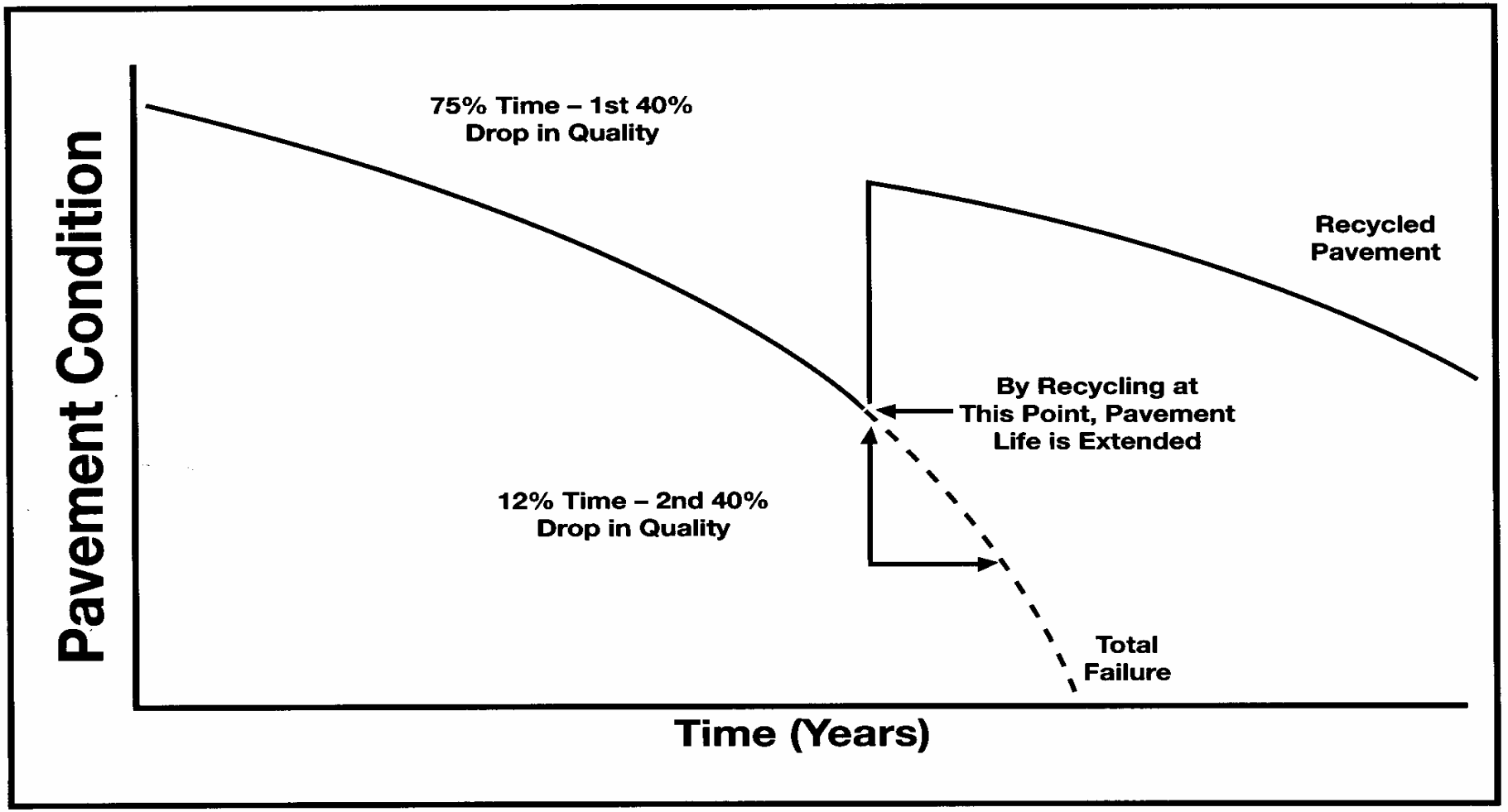
Asphalt Recycling

Full Depth Reclamation

When to Recycle

- Distressed Pavement at End of Design Life
  - Fatigue (Alligator) Cracking
- Large Oxidized Thermal Cracks
- Surface Maintenance No Longer Effective
- Excessive Raveling & Potholes, Safety is a Concern
- Life Cycle Costs Dictate

Life Cycle Costs

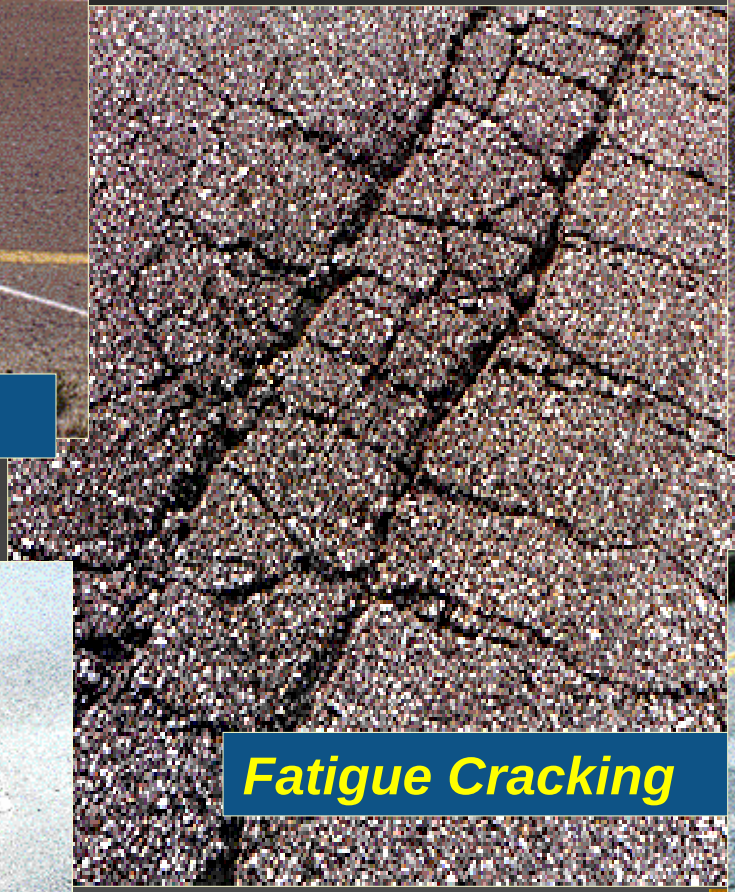


Asphalt Recycling

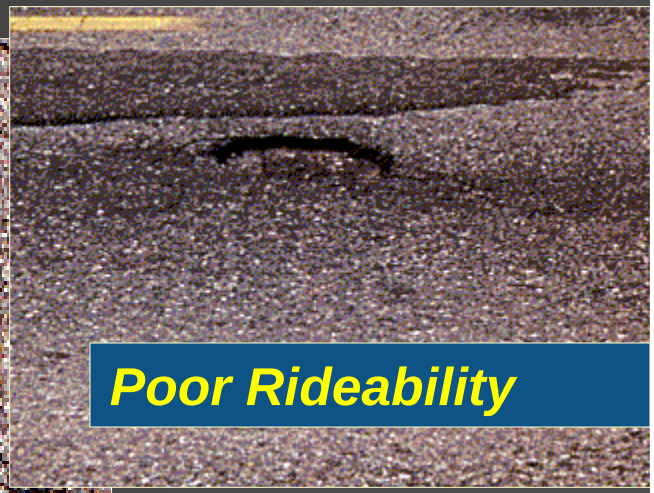
- Cold In-Place Recycling (CIR)
- Hot In-place Recycling (HIR)
- Cold Central Plant Recycling (CCPR)

WHEN to Asphalt Recycle?

Thermal Cracking



Fatigue Cracking

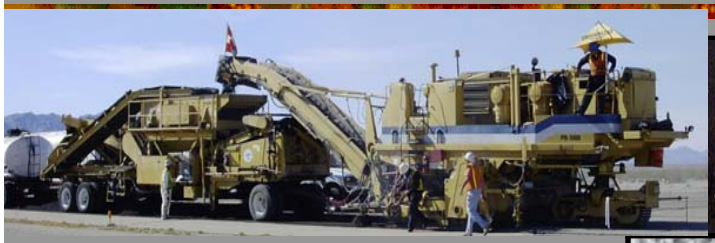


Poor Rideability

Patched

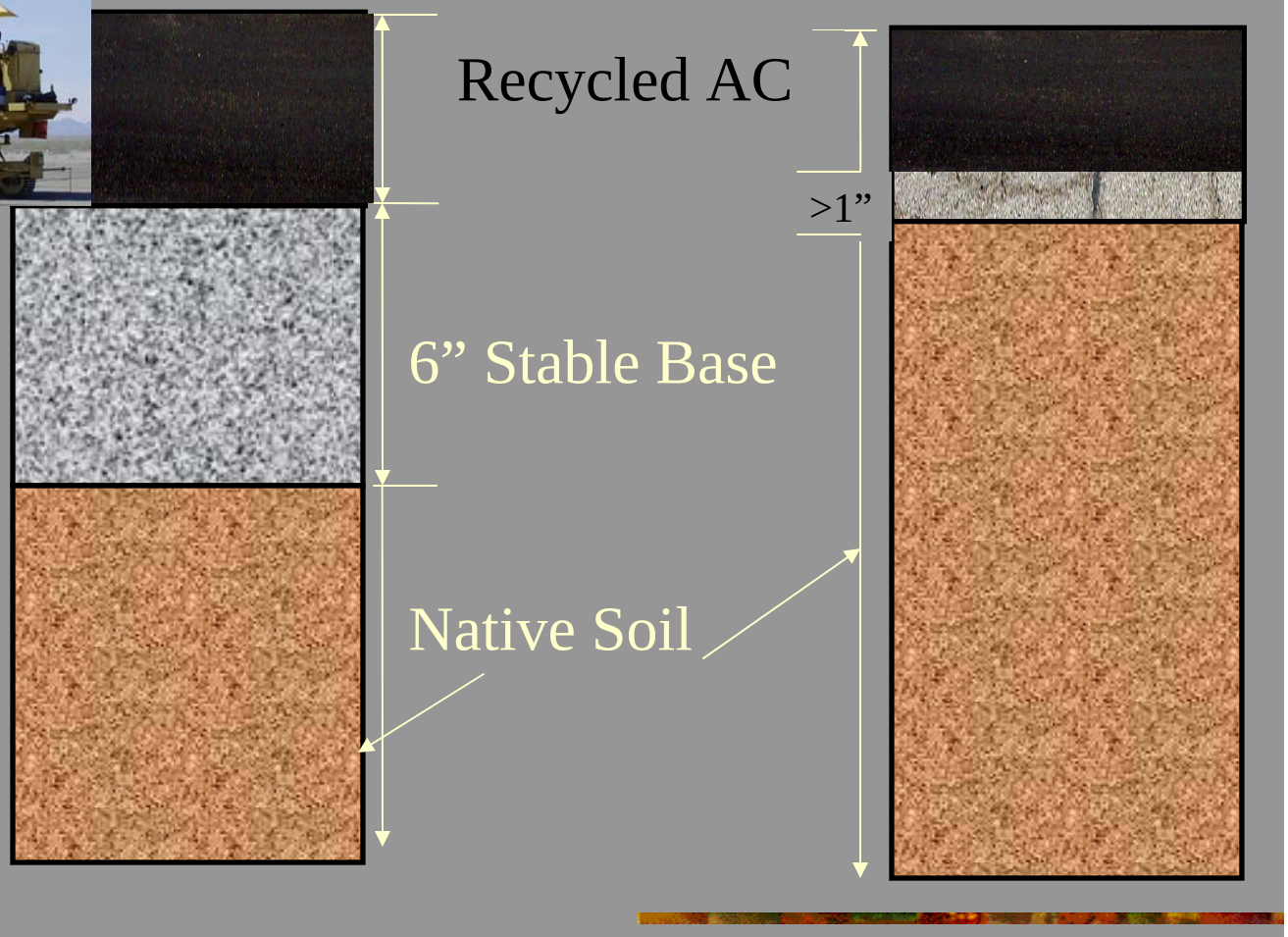
Dry, Raveled

Asphalt Recycling



Recycle AC to:

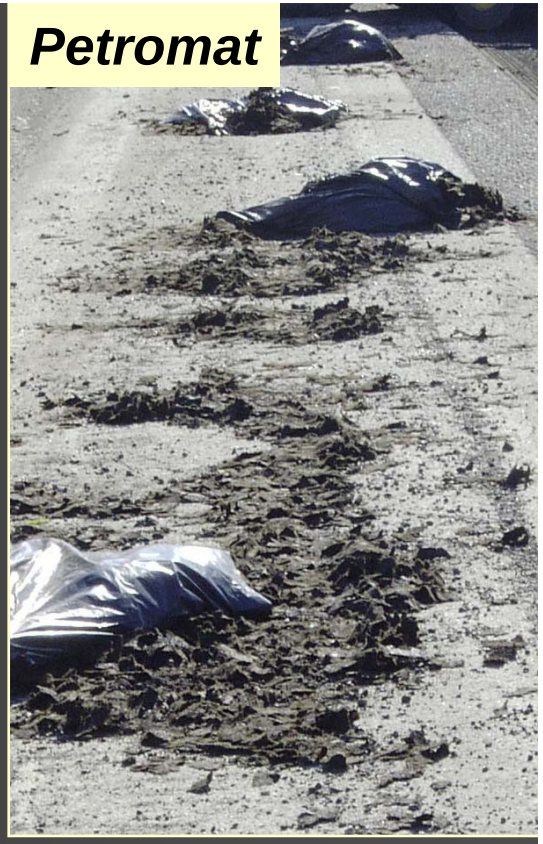
- Stable Base
- Within 1” of less Supportive Material



Pavements not to be Asphalt Recycled

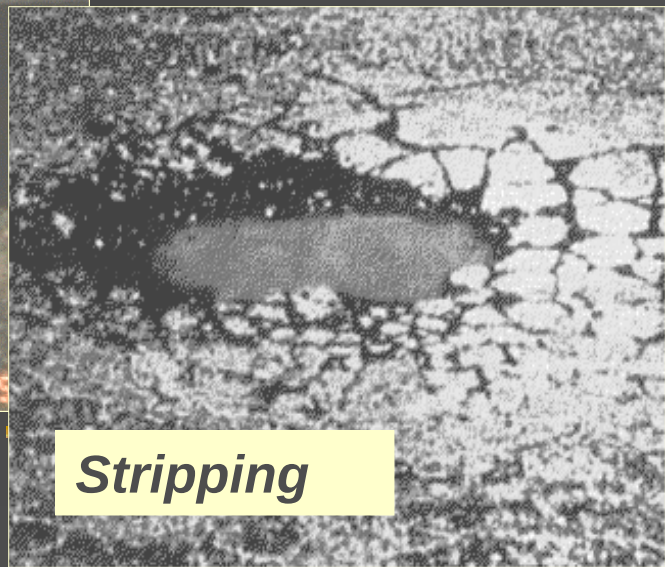
Poor Drainage

Paving fabric makes it tough!



Petromat

Poor Base



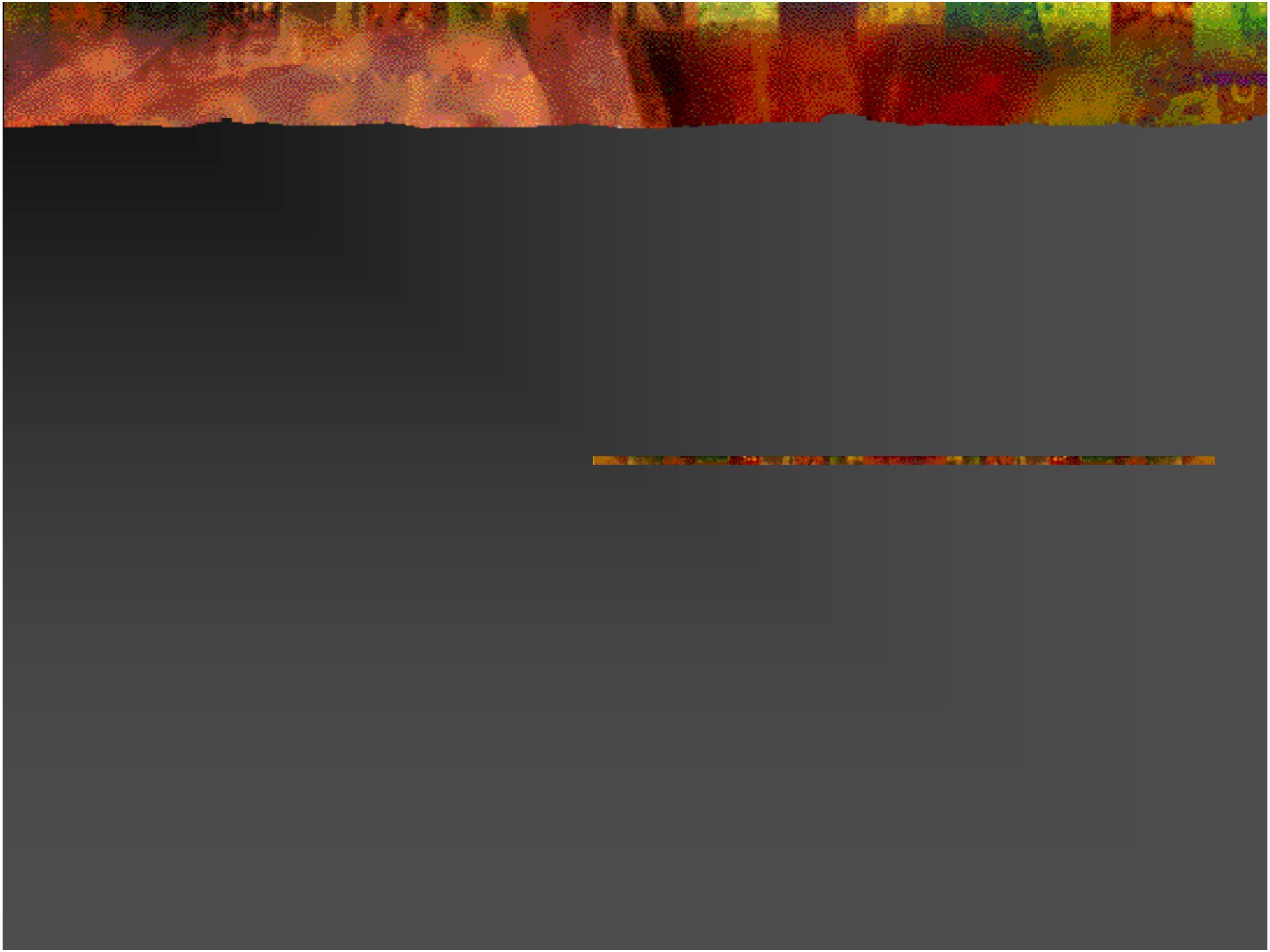
Stripping

Avoid base problems!

Cold In-Place Recycling (CIR)

Distressed Pavement = New Pavement Using A Train of Equipment that:

- **Mills** deteriorated pavement
  - Reclaimed asphalt pavement (RAP)
- **Crushes** RAP to gradation
- **Mixes** with recycling agent
- **Re-Paves** recycled mix
- **Compacts** to specified density
- **Readies** for surface treatment



CIR Recycling Train

Hot In-Place Recycling (HIR)

Distressed Pavement = New Pavement Using A Train of Equipment that:

- **Scarifies** deteriorated pavement
- **Heats** RAP and Existing Binder
- **Adds** Aggregate or Virgin Hot Mix AC
- **Mixes** with rejuvenating agent
- **Re-Paves** recycled mix
- **Compacts** to specified density

HIR Recycling

Cold Central Plant Recycling

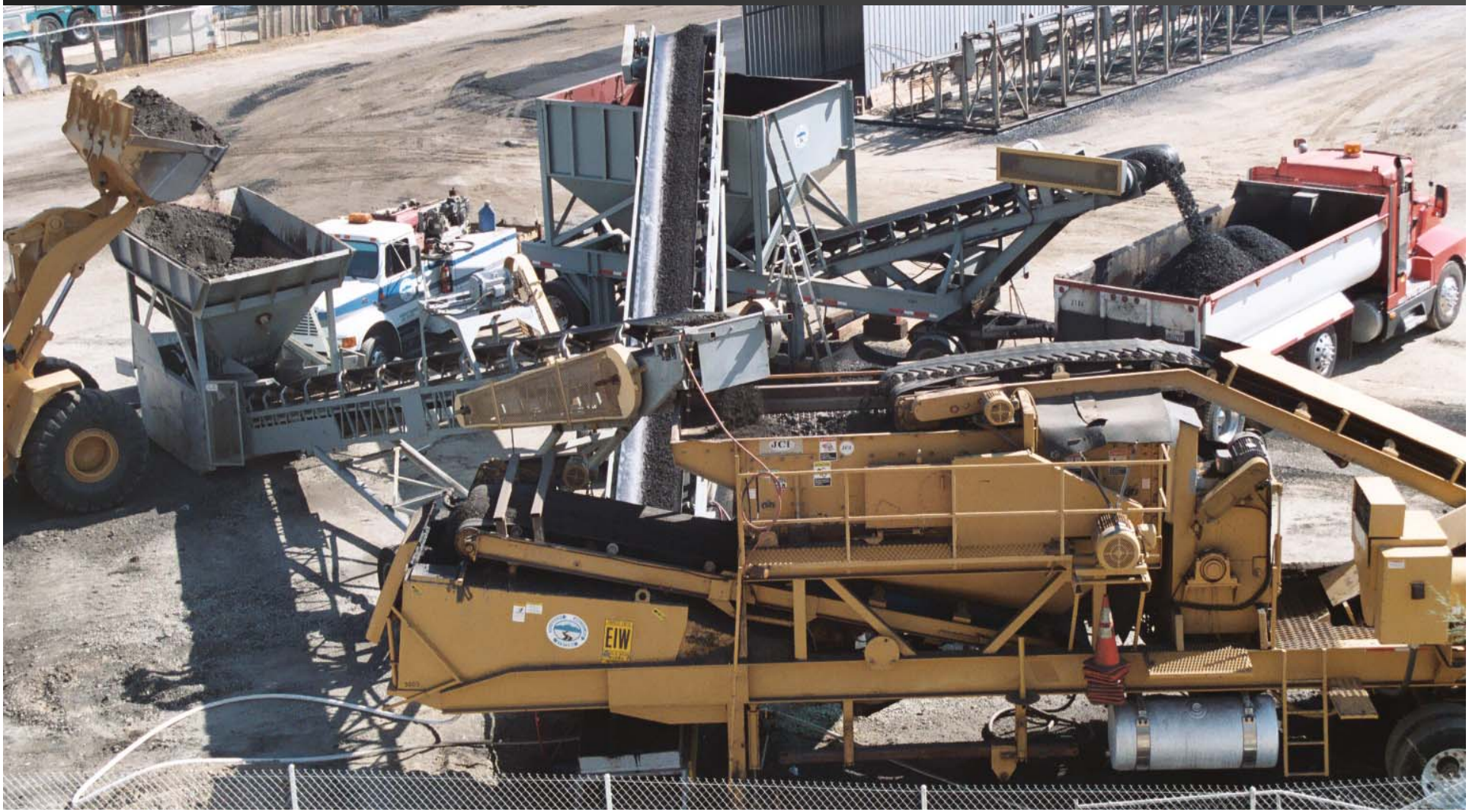
From RAP

Clean Rap = New Pavement:

- **Stockpiled and kept clean**
- **Crushed RAP to gradation**
- **Mixed with recycling agent**
  - **In central plant**
- **Transported to lay down area**
- **Paved as a recycled mix**
- **Compacted to specified density**
- **Readied for surface treatment**

to Pavement

Crushing/Mixed in Stationary Plant



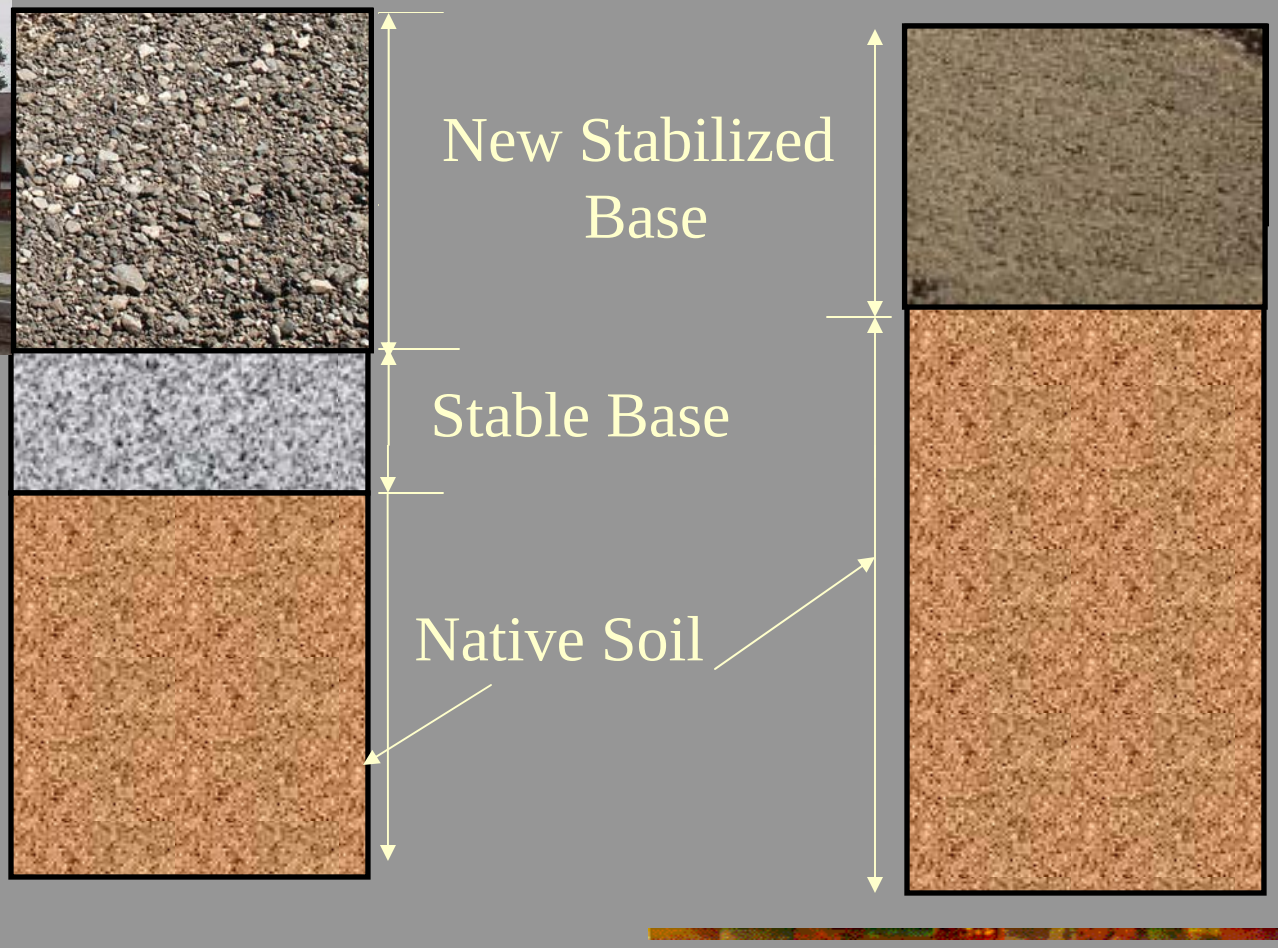
RECYCLING
Repairs Deteriorated Pavement

Full Depth Reclamation (FDR)

- Pulverization
- Mechanical Stabilization
- Bituminous Stabilization
- Chemical Stabilization

Full Depth Reclamation (FDR)

Improves existing materials in-place to provide greater structural support and reduction of imported material.



Pulverization

Full AC and a portion of the underlying materials (base, subbase and/or native subgrade) are uniformly pulverized and blended to provide an upgraded, homogenous base material.

With proper control results in Class 2 Base substitute.

Add Additives = Stabilized Base

Mechanical Stabilization
- RAP
- Gravel
- Aggregate Base

Chemical Stabilization
- Portland Cement
- Lime
- Pozzolans (Fly Ash)

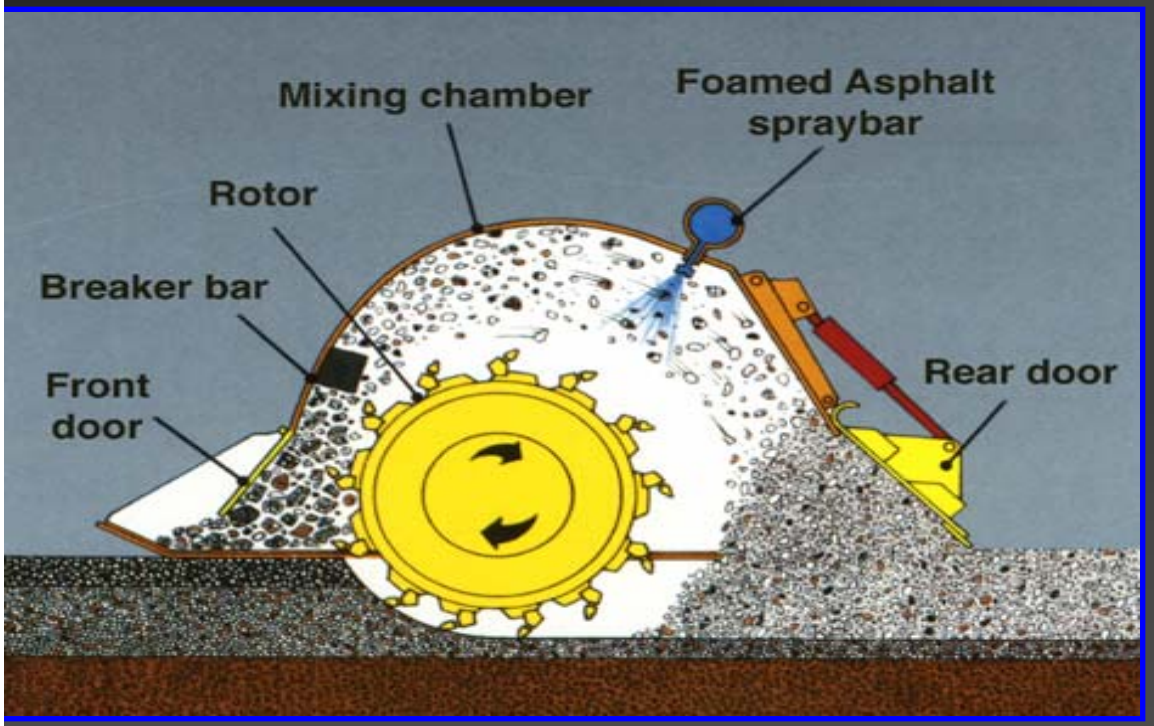
Bituminous Stabilization
- Foamed Asphalt
- Asphalt Emulsion

Asphalt Foam

- Hot AC (320F) with cold water (2-3%) in a controlled environment.
- Volume Increases up to 15 times

- Increased Dispersion
- Improved Coating

Asphalt Foam Added at Mixer



Shaped and Compacted

Structural Section Design

- Gravel factor of CFIPR is based on the ratio of the $ITS_{Treated}$ to the $ITS_{Untreated}$
  - The Tensile Strength Test is an indirect measurement of the fatigue resistance of a compacted material.
  - The untreated blend is given a gravel factor of 1.1, equivalent to Class II aggregate base, so

$$G_{fCFIPR} = [(\sum ITSr_{Treated})/n]/ITSr_{Untreated} + 0.1$$

G_{fCFIPR} = 1.3 minimum, 1.7 maximum

Why FDR?

- Uses the Value of the Existing Pavement
- Eliminates Existing Cracking Patterns
- Pulverization and Mechanical Additives Increase Base Effective Depth.
  - Caltrans Gf = 1.1 (Maybe More)
- Adding Asphalt Foam, Emulsion, Cement and/or Lime Increases Base Strength Without Excavation
  - Dramatic Increases in R Value, CBR and UCC
  - Caltrans Gf = 1.3 to 1.7
- Cost Effective

Recycling Cost Savings

- Value of Existing Aggregate and Binder
- Cost of Milling
- Trucking of Millings
- Dump Fees of RAP
- Cost of New AC
- Shorter User Delays

A Choice

EXAMPLE

Medium to Medium Heavy AADT

Mode of Failure:

- Rutting
- Transverse & Longitudinal Cracking
- Localized Base Failures

Life Required:

- 5 to 10 years

PROFILE OF EXISTING PAVEMENT

Layers of Distressed Pavement

Aggregate Base

Native Material or Sub Base R-Value 10-50

Price Comparison

REHABILITATION OPTIONS - SUMMARY

Item	Option #1	Option #2
Const Duration*	3 Days	2 Days
Cost	$70,200**	$54,500,
Expected Life	8 –10 Years***	10-12 Years

OPTION 1
Asphalt Overlay

OPTION 2
Cold Foam Recycle

* per lane Km
** 20% Digouts @ 90mm
*** Failue by reflective cracking @ 10-20mm/yr

Tips for Successful Recycling and Reclamation

- Analyze Existing Structure & Conditions
- Understand Causes for Distress
- Analyze Profile of Road
- Consider any Drainage or Base Problems
- Select Best Materials & Methods
- Use Engineered Approach

Recycling Methods
Aggregate Replacement

Recycled Asphalt Concrete Base

Recycled Portland Cement Concrete Base

Recycled Asphalt Concrete Chips

Hot Recycling (RAP in New Hot Mix AC)

WHY Use Recycled Aggregates?

- May be Better
  - Older Aggregates May Have Been From Superior Sources
- Forced to From Environmental Constraints
  - Aggregate Sources are Drying Up
  - Forced to Use Inferior Pits
- In RAP Bases Berkley Report Shows Better Performance than Crushed Virgin
  - R-Value Test May Not Represent Performance Well in Recycled Bases
  - Need New Specs and/or Testing

RAP in Hot Mix AC is a MUST!

- Education is the Key. Not “Voodoo Magic”
- Other States Routinely Use 15%. Some Even up to 35%
- The Testing Has Been Done and Proven
- Let’s Get 10% Approved For All and Any AC Mix. If All Agencies Across the State Allow It, Prices Will Come Down and Quality Will Go Up
- Hold the End Mix to the Same Quality Standards

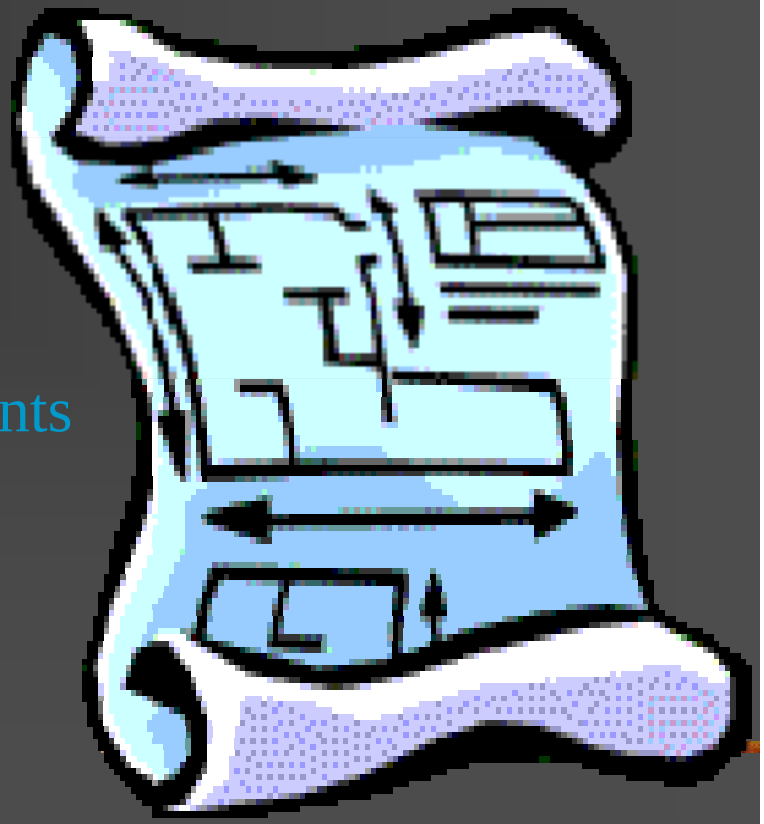
The Recycling Champions Mission:
Promote, Educate and Innovate In CA

"A good engineer can build for $0.50
what any fool can build for a $1.00"

Dwindling Budgets +

Dwindling Resources +

Demand by Public for Safe, Quality Pavements
= Need for Alternative Methods



Let's Think Outside the Box